CONDITIONING OF POWDER RESINS FROM BOILING WATER REACTORS (BWR) IN CAST IRON CONTAINERS DESIGNED FOR INTERIM AND FINAL STORAGE

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ABSTRACT

Cementation of powder resins with relatively high specific activity led to a considerable increase in the waste and to the exhaustion of the existing capacities of interim storage facilities.

To optimize the volume reduction together with minimization of radiation exposure, GNS is offering the conditioning of powder resins into ductile cast iron containers.

INTRODUCTION

In German boiling water reactors, powder resins used for purifying water circuits are dried in nuclear power plants, when their cleaning capacities are exhausted, and stored in an internal interim storage site.

In the past, these powder resins, with a relatively high specific activity, were cemented and interim stored in shielding casks. The cementation led to a considerable increase in the waste volumes and to the exhaustion of the existing capacities at interim storage facilities.

For this reason, GNS and operators of the BWR have looked for methods to optimize conditioning and to reduce volume, while guaranteeing a minimum radiation exposure for the personnel on-site. GNS and several plant operators developed and used to a large extent powder resin conditioning in containers suitable for interim and final storage.

The principle of this conditioning system is to transfer the powder resins with special suction equipment into a cast iron container offering sufficient shielding. After closure of the container, the resins can be safely handled and transported as well as stored in a final storage facility, without being reconditioned later.

The conditioning methods and results are explained in detail in this paper.

DESCRIPTION OF WASTE PRODUCT

In German boiling water reactors, dried ion exchange resins are stored in 200 l drums inside the reactor building in a drum storage. The ion exchange resins are a mixture of anion- and cation resins with additional additives. This mixture is a powder with an approx. density of 0.5 g/cm^3. The dose rate at the surface of the 200 l drums has a value between 2 mSv/h and 40 mSv/h.

DESCRIPTION OF THE CONDITIONING FACILITY (FAFNIR)

For the treatment of the waste product, the GNS facility FAFNIR is used. The main components of this facility are

- reloading station
- vacuum unit
- filling station
- control and steering unit.

The main parts of the FAFNIR facility are shown in Fig. 1.

DESCRIPTION OF THE CAST IRON CONTAINER

For conditioning and storage of the resins cast iron containers with a wall thickness between 100 mm and 150 mm is used. These containers full the specification of the preliminary repository conditions as Type VI container and the specifications of the interim storage in Germany.

The container is composed of a main body from cast iron (Quality GGG 40) and a cast iron lid with different filling openings. The main dimensions and technical information about the cast iron container are given in Fig. 2. The loading volume of the casks is due to the wall thickness which is necessary for shielding 2,8 m^3. The container lids are equipped with a double seal system. This seal system guarantees a leakage better than 1.0 E-5 Pa · m^3/s.

PROCEDURE OF CONDITIONING

The procedure of conditioning can be split into three sections

- Transport of 200 l drums with resins to FAFNIR Facility
- Conditioning of resins in the container
- Transport of container to the storage.

In a first step the 200 l drums have to be reloaded from the storage area and transported to the conditioning room. This transport is carried out with heavy concrete containers with a capacity of 8 drums. In a next step, 3 or 4 drums are equipped with a vibration motor and loaded into the container.

After closing the cast iron container with the lid an adapter is locked and the container is connected with the FAFNIR facility (see Fig. 2).

Now the conditioning of the resins can begin. For this, a 200 l drum is picked up from the concrete container and positioned in a shielding casks (Fig. 3, Pos. 1).

In position 2 (Fig. 3) with a central hole saw, the drum lid is opened. After transportation of the drum to position 3 (Fig. 3), the drum is tilted and a suction lance is inserted into the 200 l drum. Now the cast iron container is evacuated to a certain underpressure. After opening the valves in the connecting pipes, the resins are transferred by the different pressure from the 200 l drum into the container.

During the suction process, the 200 l drum rotates and the suction lance is slowly inserted by remote control.

This process is continued until the drum is empty.

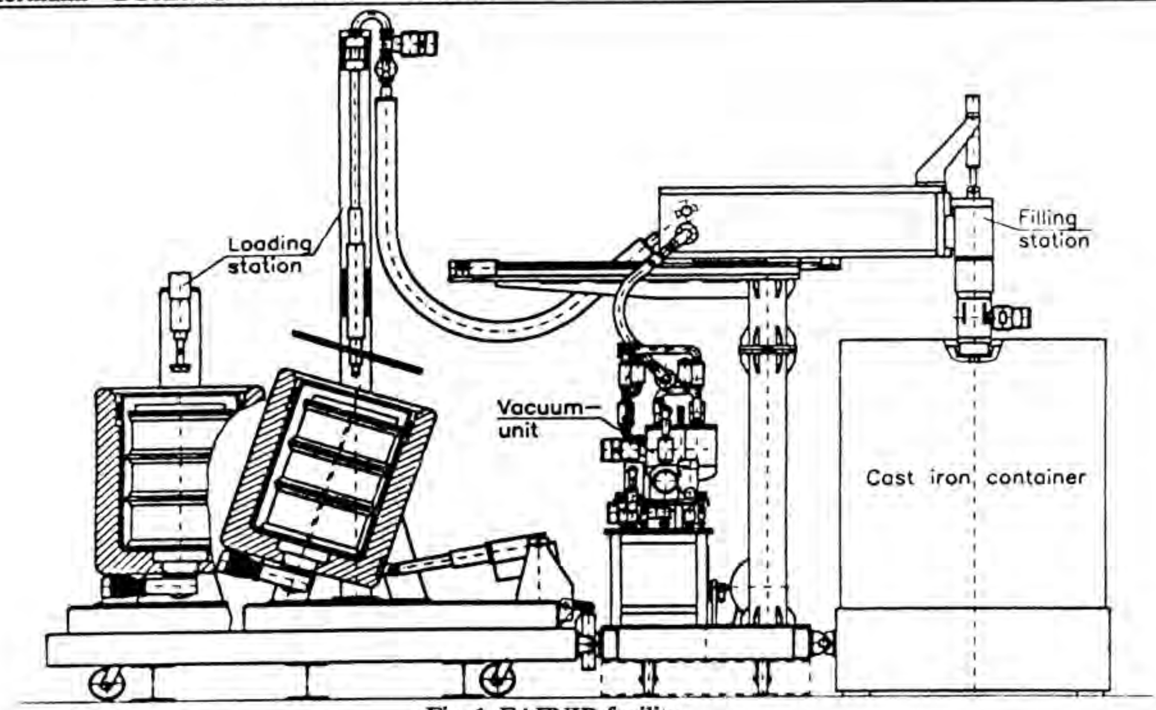

Fig. 1. FAFNIR facility.

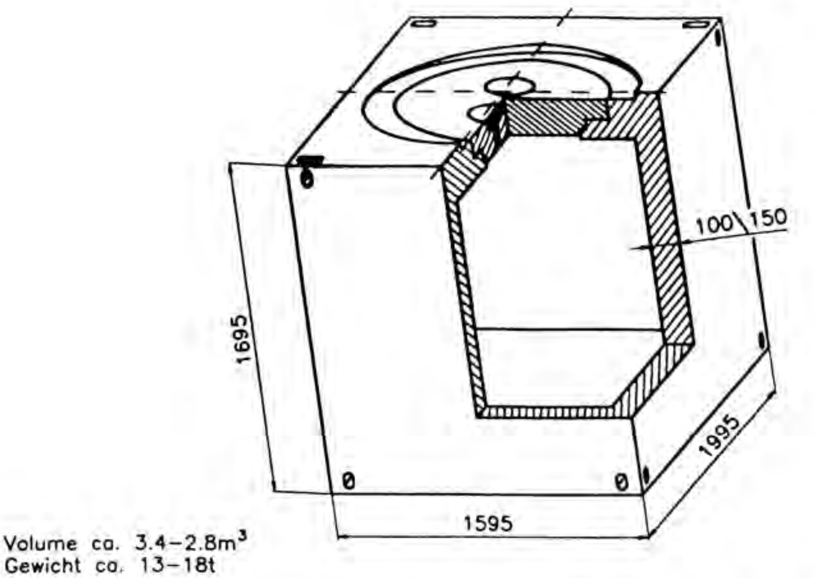

Fig. 2. Guβcontainer Type VI-cast iron container Type VI.

During suction, resin samples can be taken. Parallel to the suction process the vibration motors are in operation in order to achieve an even distribution and condensation of the powder resins.

STORAGE OF THE LOADED CASK

After loading approx. 20 drums with resins into the container, the adapter is disengaged and the container lid is closed tight. In a final step the container is transported to the interim storage area of the power plant or is ready for transportation to an external storage site.

HEALTH PHYSICS ASPECTS

In comparison with other conditioning procedures and in this case especially with conditioning by cementation, the personnel dose rate of the people involved is low. This is justified by the fact that all personnel work can be done with optimal shielding conditions or short stay in areas with higher dose rates.

The results of the optimization of the radiation protection is shown by the following.

The calculated collective dose for a conditioning campaign with 164 200-l drums (surface dose rate between 10 - 25 mSv/h) has been 35 mSv. The actual collective dose after conditioning was 8.2 mSv.

This example shows that the conditioning of dried powder resins by loading them into heavy cast iron containers gives a good volume reduction and guarantees a minimum of radiation exposure for the personnel on-site.

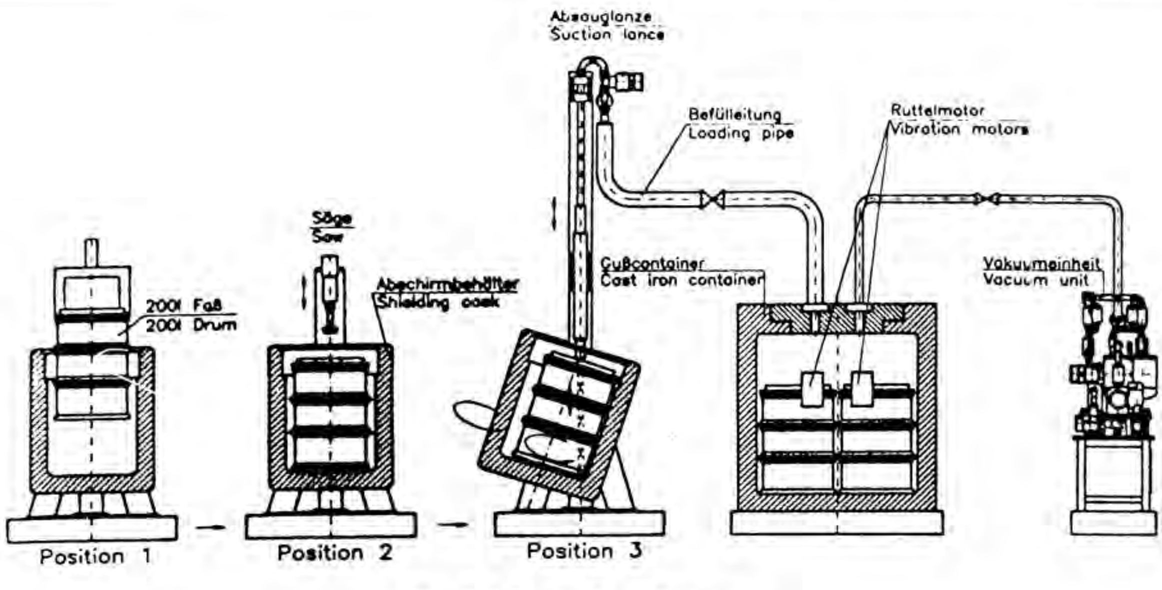

Fig. 3. Scheme of conditioning.